JPRS 77789

9 April 1981

Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

No. 90

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INDIA

INDIA PLANS PILOT PROJECT FOR NUCLEAR WASTE DISPOSAL

Bombay THE TIMES OF INDIA in English 5 Mar 81 p 5

[Article by S. Kumar]

[Text] Bombay, March 4: A major experiment on radioactive waste disposal will be jointly conducted by India and West Germany. The pilot experimental project to be set up in India will make a special type of glass contained for storing the radio-active waste permanently. Certain equipment for the project will be provided by West Germany.

Disclosing this to THE TIMES OF INDIA, Prof. A Boettcher, co-ordinator for bilateral co-operation, ministry for research and technology, the Federal Republic of Germany, said scientists at the BARC and the Nuclear Research Centre (KFA), Julich, would conduct the experiment jointly. The agreement for this project would be signed shortly by both countries.

West Germany would be collaborating with the BARC at least 24 small and big projects in the nuclear field under bilateral co-operation. [as published]

Similarly, experiments on wind energy with the National Aeronautical Laboratory, Bangalore, on desalination with the National Institute of Oceanography, Goa, and on food technology with the Central Food and Technological Research Institute, Mysore, were being conducted.

Solar Energy

For experiments on solar energy, India could provide abundant sunshine for his country, he said. [as published] But solar energy, in the present form, was far from becoming a reality despite its vast potential. He found only a propaganda value in this technology as long as its cost remained high.

To reduce the investment cost of solar equipment, the concepts of long lifetime and high efficiency of the equipment must be compromised, Prof. Boettcher said. The conventional solar collectors made of glass, metals and thermal insulations could at best help reduce the cost by 20 per cent, Prof. Boettcher said. More or less complete plastic collectors would offer a viable solution.

Prof. Boettcher has patented a PVC solar air collector which is stabilised against ultra-violet rays. The prototype collectors are now being made by the industry.

Its efficiency may be 10 or 15 per cent less but the cost is at least eight times less.

Less and less automation would bring the prices of solar equipment down and Israel had enormously succeeded in this respect, he said, after a 12-year tenure as a co-ordinator for bilateral co-operation.

PVC collectors had already been tested and were successful in Mexico. They were being tried at the Regional Research Laboratory, Jammu, for crop drying.

Solar energy should not be considered a substitute for oil but would only help in its saving, Prof. Boettcher cautioned.

CSO: 5100

COUNCIL AUTHORIZES NUCLEAR, EIGHT COAL POWER PLANTS

OW260149 Tokyo KYODO in English 0131 GMT 26 Mar 81

[Text] Tokyo, 26 Mar (KYODO)--A government council on electric power development decided Thursday to authorize start of construction of three new nuclear power reactors for the first time in two years and three months.

The Power Development Coordination Council, chaired by Prime Minister Zenko Suzuki, met Thursday to study power development projects for the fourth quarter of this fiscal year and decided to authorize construction of new power plants with a total capacity of 12.8 million kW, including the three nuclear reactors, at 15 places in the country.

Of the three nuclear reactors, two of the light-water type with an output capacity of 1.1 million kW each will be built by Tokyo Electric Power Co at its Kashiwazaki-Kariwa Nuclear Power Station in Niigata Prefecture. They are scheduled for completion in July 1989 and January 1990.

The other reactor, also a light-water type with an output capacity of 820,000 kW is being built by Chugoku Electric Power Co. At its Shimane Nuclear Power Plant in Kashima, Shimane Prefecture, for completion in March 1989.

The last time construction of a reactor was permitted was in December 1978 when the council authorized work on the No 2 reactor of the Tsuruga plant in Fukui Prefecture of Japan Atomic Power Co. No new nuclear power generation projects were permitted in fiscal 1979 due to the effects of the Three Mile Island accident in the U.S. in March 1979.

The council decided earlier to permit construction of new power facilities with an output capacity of 6.6 million kW in fiscal 1980.

With Thursday's decision, the new facilities authorized for start of construction in fiscal 1980 will total 19.4 million kW, surpassing the previous record of 17.3 million kW in fiscal 1970.

It also accounts for 92.6 percent of the target figure of 21 million KWs set by the government earlier as new power development undertakings for this fiscal year.

Among other projects authorized by the council Thursday were the start of construction on eight coal-fired power units at four places with a total output capacity of 5.8 million kW. They include a 600,000-kW-capacity unit to be built by Hokkaido Electric Power Co. At its plant in Tomatoazuma, Hokkaido for completion in January 1985 and three units of 600,000 kW each to be built by Tohoku Electric Power Co at its Noshiro plant in Akita Prefecture for completion in February 1988, June 1991 and June 1992.

The output capacity of 5.8 million kW of the eight new coal-fired power units allowed for construction surpasses the 5.3 million kW of such coal-fired plants now in operation. This indicates that the government's plan to develop coal-fired power plants along with N-power plants to replace oil is progressing smoothly.

The council's decision to permit the start of construction on the eight coal-fired units was taken in line with the agreement reached at the economic summit of major western industrialized nations in Venice last year banning construction of oil-fired plants.

The council also had planned to authorize work on building of two nuclear reactors at the Genkai Nuclear Power Plant in saga prefecture of Kyushu Electric Power Co and a reactor at the plant in Maki, Niigata Prefecture, of Tohoku Electric Power Co but no decision was made on them because of a delay in negotiations with local fishermen on compensation.

The government hopes to permit construction of the three reactors during this year if possible.

CSO: 5100

CONGRESSMEN OPPOSE GE TECHNOLOGY FOR LAGUNA VERDE

Mexico City EL DIA in Spanish 17 Mar 81 p 3

[Text] The Legislative Energy Commission (CLE) "will take very clear steps" to assure that General Electric technology is not employed in the construction of the nuclear electric complex at Laguna Verde, Veracruz--that same technology that, some time ago, was prohibited in the United States for having caused an atomic explosion [sic] at Three Mile Island in that country.

This was the statement issued by congressman (diputado) Jose Maria Trellez Rincon, a former leader of the Mexican Electrical Workers Union (SME) and member of the aforesaid commission, in expressing "our concern" over the technology that is being employed in the construction of Laguna Verde.

He stressed that Mexico "cannot accept an obsolete technology like that of General Electric because, later on, it will be we who will have to replace it and this will result in more losses and delays in the completion of the nuclear electric project."

The legislator also expressed his "concern" that there still has not been decided what type of uranium will be employed to power the plant--"there is talk of using that mineral enriched in the United States when we have great quantities of it in its natural state."

He commented that, within the legislative group making up the Energy Commission "there are those who are opposed to enriched uranium being used at Laguna Verde."

CSO: 5100

BRIEFS

OAPEC OFFICIAL ON URANIUM--Kuwait, SANA--Dr 'Adnan Mustafa, assistant secretary-general of the Organization of Arab Petroleum exporting Countries (OAPEC), stated that the Arab region, in addition to its oil, is rich in the other energy substances, such as uranium, because 50 percent of the world's phosphates are located in Arab soil. Dr Mustafa informed a Syrian-Arab News Agency correspondent in Kuwait that 3000 tons of Arab uranium are being wasted every year through the annual export of 30 million tons of phosphate. He commented on the tremendous natural gas reserves in the Arab region. He asserted that 16 percent of the total world reserves of this substance belongs to the Arabs, and that it is very likely the reserves are four times greater than his current estimates. [Text] [Damascus AL-BA'TH in Arabic 29 Jan 81 p 2] 9650

CSO: 5100

UNITED ARAB EMIRATES

RIDDLE OF NUCLEAR WASTE VESSEL CONTINUES

Kuwait KUWAIT TIMES in English 21 Feb 81 p 1

[Text]

THE United Arab Emirates authorities are still busy try'ng to solve mystery surrounding the motives behind the Greek ship "Freighter Ninty", which keeps coming to the regional water of this Gulf Emirate.

The concern of the authorities stems from the fact that the ship was ordered away but it re-appeared in the Emirate waters without crew on boad.

The quit — Emirate order to the ship followed the discovery that it was laden with nuclear waste.

The story goes back to Feb 3 when the 4,200 tonnage ship entered the UAE waters with 182 tonnes of nuclear waste on board without declaring it. Fearing that the nuclear waste cargo might be dumped in the Gulf waters or in the desert the ruler of Ras-Al Khaima Sheikh Sagar Al Hashimi ordered the ship out of the Gulf regional waters.

TRIAL

Soon afterwards the ship anchored at Al Sharga but this time without any crew on board. The ship was then towed to the regional waters of Oman and the Omani authorities were informed of its cargo.

According to press reports the United Arab Emirates authorities informed all the Gulf states of the dangerous cargo of the ship which remained in the Omani waters and ordered an immediate enquiry into "the mysterious case" of the ship.

The Interior Ministry Under-secretary of the United Arab Emirates said the ship's representative and all those who facilitated its arrival to the port will be interrogated and that anybody found guilty will stand trial.

RETURN

The vessel is reported to have sailed from Greece about a year ago carrying the nuclear shipment and headed for Djibouti on the Red Sea, but Djibuti discovered the truth about the cargo and ordered the ships out of its waters.

The ship sailed to Pakistan but was towed from there to the Emirate. It is now believed to be returning to Pakistan again.

The British Lloyds Insurance Company of Londan claimed that there are three ships registered under the same name but they carry numbers from one to three. The ship in question is numbered one said the insurance company which did not say whether the ship was insured with them. —Kuna.

CSO: 5100

INTER-AFRICAN AFFAIRS

CONSORTIUM TO MINE URANIUM IN GUINEA

Rangoon THE WORKING PEOPLE'S DAILY in English 9 Mar 81 p 4

[Text] **Dakar** (Senegal), 7 March—Nigeria is prepared to take a one-quarter share in an American- European- African consortium to prospect and mine uranium in Guinea, where eight deposits were discovered recently, Guinean Radio monitored here said.

The radio was reporting on the visit of Nigeria's Energy and Mines Minister, Mohammed Ibrahima Hassan, and added that there would be a meeting in Conakry Tuesday through Thursday between the Guinean and Nigerian governments and several US and European companies.

The goal of the meeting would be to "harmonize the interests of all the parties in the project and define the nature of .. agreements of association in a public-private company".

The French state group Cogema has had the responsibility of uranium prospecting in Guinea. It was not clear how the proposed new company would affect Cogema, which already mines uranium in Niger and Gabon.—*NAB AFP*

CSO: 5100

PROSPECTS FOR NIGERIAN NUCLEAR BOMB DISCUSSED

Capetown DIE BURGER in Afrikaans 25 Feb 81 p 15

[Report: "Nigeria Aims at Nuclear Bomb for Struggle Against South Africa"]

[Text] Salisbury--Nigeria, which because of its oil is the only prosperous Black African state and [which is] nowadays at the forefront of the black hostility toward South Africa, is giving indications that it is beginning to think about procuring nuclear arms for itself.

If this happens, Nigeria will be the first country in Black Africa with such weapons at its disposal.

The news that Nigeria is beginning to be interested in nuclear arms comes in the midst of increasing suspicion that the country of President Shehu Shagari will form the nucleus of a Black African army intended to be used against South Africa.

Undoubtedly no one in the world was surprised when President Shagari himself recently stated at Lagos that his country will have to begin thinking about nuclear arms because South Africa has reportedly developed a nuclear bomb. Nigeria, so he said, will remain outside of the world of the "nuclear club" only if no country in Africa succeeds in getting nuclear arms.

If South Africa begins the race for nuclear arms, so he warned, the eventual result will be "simply frightful" for world peace.

The farthest Nigeria has as yet been able to proceed on the nuclear road has been the establishment of a nuclear research board. Nevertheless, Nigeria has at its disposal extensive reserves of uranium, which will have to be enriched before it can be used for a nuclear bomb.

It would surprise no one, however, if Nigeria's oil leverage against countries such as France and even the United States would be used to get a nuclear reactor. Technicians will always be scarce, but with a great deal of money nuclear physicists can be bought. It is also practically certain that countries such as India, Pakistan, the Soviet Union, and [the People's Republic of] China will be only too glad to help.

Many black Nigerians regard the entire matter of a nuclear bomb as necessary for their survival. Blinded by hatred toward South Africa, they believe that South Africa will try to obliterate them with a nuclear bomb.

Bolaji Akinyemi, director-general of Nigeria's Institute for International Affairs, is one of those who think this way. He recently warned that Nigeria should first think of its survival as a nation before it can begin to think of development. Therefore Nigeria should get its nuclear bomb before South Africa's becomes a threat.

He said that a nuclear bomb is no longer a luxury nowadays but a necessity.

The question is, however, whether Nigeria's economy will be able to afford the expenditure of the development of such a nuclear bomb. Nigeria does have a vast production of oil--which it sells chiefly to France, the United States and European countries--but [the development of] a nuclear bomb costs thousands of millions of rands, and Nigeria can hardly afford that at this stage of its development. Millions of blacks in Nigeria are still illiterate, the country has to import practically all of its food, and so forth.

It looks then as if the procurement of a nuclear bomb is much rather a luxury which Nigeria regards as necessary for its role as leader of Black Africa--a role which it is planning to expand.

The first indications that Nigeria regards itself as more than an African state came several years ago when that country suddenly joined the rank of the so-called front-line states against South Africa. And recently Nigeria was also present at the summit conference of the front-line states in Lusaka.

Although this is still unconfirmed, it is asserted here that Nigeria agreed at this conference to form the nucleus of a black army against South Africa. Such an army, which is supposed to counter South Africa's "aggression," has been urged for a long time, but funds have always constituted the problem.

Following South Africa's raid on the ANC at Maputo, it was probably decided to proceed with the establishment of such an army at the next general assembly of the OAU. The army will then, for example, be used in Angola to counter South African raids on SWAPO bases and even to invade South-West Africa in an attempt to eliminate South African bases.

The costs of such an army will be footed by the OAU and in particular by Nigeria. It will supply most of the soldiers and it will provide supplies such as food for the host countries.

It is asserted here that such an army will also constitute a part of a joint defense agreement recently discussed by the front-line states.

Nigeria is apparently also worried that South African planes may get at it while it is busy supporting such an African army. Hence the talk about and the urgency of a nuclear bomb.

It also looks as if Nigeria wants to use the specter of South Africa to get a nuclear bomb which it can employ against other African states. Nigeria and Colonal Muammar Qadhdhafi of Libya, for example, are not at all in agreement following Libya's merger with Chad.

5742
CSO: 5100

ADDITIONAL URANIUM EXPLORATION LICENSES SOUGHT

Lusaka DAILY MAIL in English 13 Mar 81 p 7

[Excerpt] **MORE INTERNATIONAL companies are negotiating with the Zambian government for uranium prospecting and exploration licences in addition to the four groups already in the country and spending about K10 million annually.**

This was said on Wednesday evening by the Director-General of the National Commission for Development Planning, Dr Leonard Chivuno, when he addressed participants to the month-long mining industry management development course at the Copper Chalice Hotel in Lusaka.

Dr Chivuno, who spoke on "The Third National Development Plan and the Role of the Industry in Planning," said a new development contemplated in the plan which will have, however, only a long term importance on energy supply is uranium prospecting and exploration.

"At the moment, four exploration groups are in the country spending annually about K10 million and many more are negotiating licences."

CSO: 5100

NEW ECNR RESEARCH PARTICLE BEAM ACCELERATOR

Paris LE MONDE in French 11 Mar 81 p 19

[Article by Maurice Arvonny; "Proton-Antiproton Collision: A New European Research Installation to Produce Particles Which Do Not Exist"]

> [Text] The European Council for Nuclear Research (ECNR) recently revealed that a beam of antiprotons had been raised to the energy level of 26 billion electron volts (26 GeV) in an apparatus used up to now the accelerate protons (LE MONDE, 15-16 February). This is an important step in the realization of a grand project with which Europe will take a sure step ahead of the United States. It involves the acceleration, within the same circular annulus, of antiprotons rotating in one direction and of protons rotating in the opposite direction. The two beams will cross each other at a number of points where physicists will place their apparatus to observe what occurs. By this procedure energy levels otherwise unattainable can be reached and hence a new domain of physics opened.
>
> From experiments which will begin at the end of summer a large number of discoveries is expected, in particular proof of the existence of particles yet unobserved but predicted by theory. As a matter of fact this installation should, for several years, keep the physicists who are working at the ECNR occupied while they are waiting for the LEP, the large ring for electron-proton collisions to enter into service. This may come about at the end of the present decade; it will be a new step in the study of very high energies. That is, if the LEP is decided on. A decision is expected this year but at present Sweden is hesitating.

The proton is a particle which exists in abundance in nature: it is the nucleus of the hydrogen atom. For 50 years it has been known how to generate sources of protons providing intense beams of determined direction and velocity. Such beams can then be accelerated in accelerators of various kinds. Those of the ECNR are synchrotrons, wherein the protons rotate within a circular annulus and receive a small acceleration at each revolution which progressively increases their energy. The ECNR has two synchrotrons: the PS (proton synchrotron) was placed into service in 1959 and raises protons to the energy level of 26 GeV; the SPS (proton supersynchrotron), in service since 1976, takes the protons accelerated by the PS and raises their energy level to

500 GeV. These protons are then withdrawn from the SPS and made to strike targets. Physicists are studying the interactions between these protons and the matter of the targets.

Every motorist knows very well that, if he is traveling at 100 km per hour, it is not at all the same thing to collide with a stopped vehicle as with a vehicle traveling at 100 km per hour in the opposite direction. In the latter case all of the vehicle's kinetic energy is absorbed in the collision and serves to deform the vehicle's body... and the body of the occupant whose chances of survival are practically nil. In the former case half of the energy sets the vehicle which had been stopped into motion and only half does the work of deformation. The prognosis is less somber for the driver.

The Laws of Relativity

It is the same for the protons except that Einstein's laws of relativity and not those of classical mechanics must apply. It is then found that in a collision between a proton of 500 GeV and one that is stationary most of the energy -- and not half as in the case of the automobiles -- serves to set the stationary particle into motion. Only 30 GeV are actually used to "deform" the protons in the collision and create the phenomena which the physicists are studying (production of particles which do not exist in nature).

That is why the ECNR in 1971 was given a third apparatus: the ISR (Intersecting Storage Rings). These are two rings into which are directed two proton beams coming from the PS. The directions of rotation in the two rings are opposed and what happens at the points of intersection can be observed. The collisions are analogous to that of two automobiles traveling in opposite directions: all the available energy is indeed utilized; although the energy of each of the proton beams is limited to 26 GeV, this makes a total of 52 GeV and the collisions are more "violent" than those of the 500 GeV protons from the SPS when they encounter stationary protons.

But it has been known for a long time that it would be of more interest to cause collision, not of two proton beams, but rather of a proton beam and an antiproton beam. The antiproton is the antiparticle associated with the proton and the general rule is that particle and antiparticle can destroy each other in a collision. It is found that more knowledge can be gained from such annihilation of a proton and an antiproton than from the simple proton-proton collision. Besides, any apparatus which accelerates protons can also accelerate antiprotons and even do the two things simultaneously. The only condition is that protons and antiprotons rotate in opposite directions -- but that is precisely what is needed for one to be able to observe their collisions and mutual annihilations.

The difficulty is that antiprotons do not exist...at least in nature. They can be created from protons. But they go off in all directions and, until the last few years, it seemed vain to hope to create a beam fine enough and intense enough to enter the narrow tube of an accelerator.

The first idea came from the Soviet research center at Novosoibirsk where Gersh Budler in 1967 proposed "cooling" the antiprotons by mixing them with electrons. The idea merits explanation: by collecting the antiprotons emitted upon collisions of protons with matter an antiproton beam can be created. But that beam will be wide and of heterogeneous velocity: some antiprotons will be moving a little faster than others, and likewise the directions will be slightly different. It can be considered that this wide and diffuse beam differs from a fine and parallel beam by a small, uncontrolled agitation of each particle. Now such uncontrolled agitation has a name: it is heat. The antiproton beam which we know how to create is hot whereas the one desired, indeed homogeneous and parallel, is cold.

How to cool a hot object? By transferring the heat to a cold object, whence the idea of causing the antiprotons to circulate in the medium of a well-cooled electron beam. And it is found that the uncontrolled agitation, the heat, is effectively transferred from the antiprotons to the electrons. The experiment was performed at the ECNR and yielded the expected results. After separation of the antiprotons and the electrons a much finer and regular antiproton beam than the one at the start is obtained.

However, it is not this method which was finally selected but another, invented by Simon Vander Meer, a ECNR engineer. Called "stochastic cooling," at is based upon a somewhat less simple principle. The idea is to measure the velocity of each proton [as published - antiproton?] and to apply to it the correction necessary to bring its velocity to the average value of the whole. The antiproton beam is made to rotate in a small ring (AA in the figure) whose tube is very wide. The velocity of an antiproton is measured at a given point and the connection applied when it passes the point diametrically opposite.

But several hundred billion antiprotons pass the measurement point at the same time: therefore only the average of velocities and trajectories can be measured, and the correction applied will also be an average, good for some particles [as published - antiparticles?] and poor for others. A rather complicated theory indicates, however, that the treatment is beneficial and that after a few seconds - which is several million rotations - practically all the antiprotons will have had their trajectories connected; the beam will be "cooled."

A Leap Into the Unknown

The scheme of the project is as follows: the protons accelerated by the PS to 26 GeV are made to strike a target. The antiprotons created, whose energy is 4 GeV, are collected and directed into the ring AA. After cooling they are injected into the PS and also accelerated to the 26 GeV energy level. Next they are directed into the SPS adc immediately thereafter the PS directs protons at the 26 GeV energy level into the SPS. Then the SPS simultaneously accelerates the two beams to 270 GeV.

It will be next August or September when the first collision experiments in the SPS begin. But in the next few weeks antiprotons of 26 GeV will be directed into the ISR and caused to collide with protons of the same energy level. This will permit a preliminary evaluation of what proton-antiproton collisions can provide.

Much is expected from them. First of all, the creation "light basons." These particles have been predicted by theories well confirmed in other respects and there is therefore reasonable certainty of their existence -- in any case, not finding them would be a tremendous surprise. But they require too much energy to be created by present installations.

It is also hoped to see "Higgs basons." These are a species of particle still more "theoretical" than the weak basons and of which almost nothing is known except that there is all the more chance of seeing them as heavier particles are created, therefore, as increasing energy is available. And since its is not even known how much energy is necessary -- in contrast with light basons -- the experimenters are truly dashing into the unknown.

The Physicists' Flair

Many other discoveries are possible -- all that the theoreticians imagined, and even what they did not conceive! But the difficulty is to separate the interesting phenomena, which could be drowned in an intense background noise resulting from the creation of particles which are already well understood. The advantage of the LEP over the present project is a great reduction of this background noise.

Around the points on intersection the physicists indeed have enormous apparatus making it possible to measure the characteristics of the particles produced in proton-antiproton collisions. Lengthy calculations will next make it possible to reconstruct the trajectories and establish relationships. For these particles which are being sought have far too short a life to go as far as the detectors. It is their "daughters" or "granddaughters" which the apparatus will detect.

But they will detect so many things that it will be impossible to analyze everything. And it is there that science and perhaps the flair of the experimenters will be fundamental. Choices must be made. For example, only events where certain particles of a given type are measured, within certain angles and at certain energy levels, are of interest. Only those collisions which satisfy such conditions will be taken into account. The problem is therefore indeed to select the conditions which are to be imposed. This will be done by trial and error - and this also explains the differences in design between the two competitive experiments which will at first be effected.

One, organized by collaboration of 11 laboratories* and 100 physicists is an enormous assemblage of detectors placed within a large magnet incurvate about the trajectories of the particles. All told there are three successive detection levels: the first for the so-called heavy particles, the second for electrons, and the third for muons - a kind of heavy electron, less easily stopped than electrons.

The other experiment is approximately only half as large as far as the number of laboratories, physicists, and apparatus is concerned. It places more emphasis on detection of electrons, less upon detection of muons. The advantage is that it will be simpler to control and will be able to provide certain results more quickly. On the other hand, other results will be unobtainable by it. Next year we shall see which of these two complementary apparatus has been the more fruitful.

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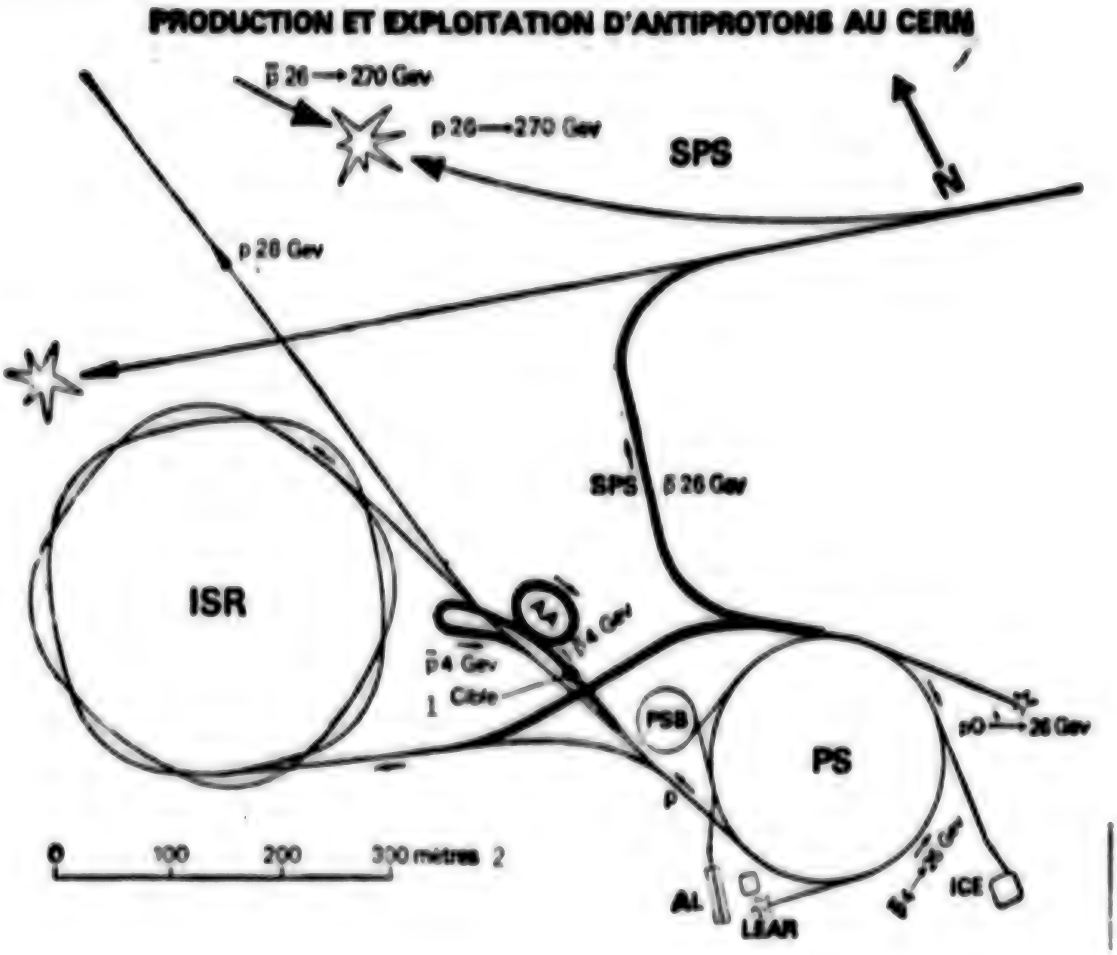
*Three French laboratories (Annecy, College de France, and Saclay) are participating in this experiment. In the second experiment the French participants are coming from Orsay and Saclay. Three other experiments are in preparation and will be installed after the first two.

Production and exploitation of antiprotons of the ECNR



Key:
1. target
2. meters

The figure shows the installations of the ECNR. The portions which were added for acceleration of antiprotons are in heavy lines.

A beam of protons - hydrogen atom nuclei - exit in gusts from a small linear accelerator (AL). After passing through an intermediate accelerator (PSB) the protons (disignated p) are raised to the 26 GeV energy level by the PS. From it they are extracted and directed against a target. The antiprotons, whose energy level is close to 4 GeV (designated p with a dash on top) are collected in the antiproton accumulator (AA) where they are subjected to stochastic cooling. They are then reinjected - in the opposite direction - into the PS and accelerated to 26 GeV. From there they can be directed to the ISR or the SPS. Protons at the same energy level are also directed into these apparatus and collisions at 26 GeV in the ISR, or at 270 GeV after simultaneous acceleration of protons and antiprotons in the SPS studied.

The figure also shows two auxiliary apparatus. ICE is an installation which has served in the study of stochastic cooling and which enabled the effectiveness of the process to be demonstrated. LEAR is a ring which will receive antiprotons which have been slowed and not accelerated: these low energy antiprotons are a tool for study of the structure of atomic nuclei.

11706
CSO: 5100

NUCLEAR FUSION PROJECT STOPPED FOR LACK OF FUNDS

Hamburg DIE ZEIT in German 27 Feb 81 p 64

[Article by Doris Freiberg: "Gone With the Wind. Planned German Nuclear Fusion Project 'Zephyr' Halted Because of Costs']

[Text] Zephyr, the gentle wind out of the west, was supposed to give wings to the nuclear researchers in Garching near Munich, but it did not carry them far. At the beginning of the year the Zephyr project was stopped for lack of funds.

The people in Garching had had big plans: When the European experimental nuclear fusion plant JET--to date the most expensive array of equipment in this sector in Europe, with DM500 million planned for it--had been sold to the competitor's laboratory in Culham near Oxford, England, the Max-Planck Institute for Plasma Physics in Garching decided to venture the next physics-based step. The fusion of hydrogen nuclei releases energy, yet for economically profitable quantities this requires a plasma--a million degrees of hot gas--which constantly reheats itself from the newly developing energy. This suggests the analogy with combustion. Once "ignited," the gas continues to burn on its own.

As simple as all that sounds, it is very difficult to achieve because the "ignition point" is somewhere around 150 million degrees. And it is not such a simple thing to produce such a hot gas, to say nothing of getting it under control. On the basis of research results from the past few years solutions did in fact emerge for individual partial problems, yet all these processes combined required an apparatus which would have moved into the billion mark range.

In planning the Zephyr (Zuendexperiment fuer die Physik im Reaktor [ignition experiment for the physics in the reactor]), the Garching experts had very quickly reached agreement that the system should become a tokamak, since worldwide there were the most experiences available for this kind of plant. A tokamak consists basically of electric coils which together produce a ring-shaped magnetic field. With the help of this magnetic field the plasma is contained and kept from the walls of the vessel to the extent possible. For Zephyr, 16 oval coils were planned, each with an average diameter of about 4 meters and a current of 45,000 amperes to pass through them.

Using a gigantic transformer the physicists wanted to produce in the plasma ring itself a current of 3.6 million amperes which was to help contain the plasma and heat it at the same time. This so-called ohmic heating, which basically functions like an electric hot plate, can heat the plasma to about 10 to 20 million degrees. In order to reach the 150 million degrees necessary for "ignition," a combination with other heating methods is required.

In the Zephyr, heating was to be linked to so-called "fast neutral particles" which have to be injected from outside and which transfer their energy to the plasma by means of collisions. After this "preheating" the plan called for compressing the entire plasma ring by an abruptly amplified magnetic field and thus to continue heating it even more. According to available calculations the plasma ultimately resulting was supposed to have properties which permit independent "continuous burning" without the addition of energy from outside.

A compelling prerequisite for such an "ignited" condition is among other things the fact that the plasma is mixed together out of heavy and superheavy hydrogen (deuterium and tritium), which would be a novelty in European nuclear fusion research. To date, plants of comparable size have been operated only with normal hydrogen or with helium, relatively harmless substances compared with radioactive tritium: the superheavy hydrogen has a half-life of 12.3 years (a specific amount disintegrates in this period to half in any given case) and in addition has the disastrous property of penetrating metal walls. But only deuterium and tritium fuse so easily and in the process release sufficient energy--in addition to a helium nucleus and a neutron.

The necessity of working with radioactive gas naturally requires a whole series of special facilities. The entire plant must be capable of being operated by remote control, and not only during normal operation, but all the more so in the event of repairs or rebuilding. Moreover, it also requires a licensing procedure consistent with atomic law.

Yet before the first steps were initiated for this process, Minister for Research Andreas von Buelow stopped the project. In his view the budget cuts in the 1981 budget year made this step mandatory. Von Buelow justifies his rejection by saying: "In the opinion of the experts, Zephyr would cost at least DM500 million; in the event the licensing process turns out to be complicated, the estimates range as high as even DM1 billion. Actually we can finance projects of this magnitude only on an international basis. We should first wait for the results which the JET project will produce. Not until then can we answer the question whether nuclear fusion can actually be done on economic scales. Garching must integrate itself into the concept of overall international nuclear fusion research."

Of course the Garching people had this integration in mind when they were planning the Zephyr project. They proceeded on the basis of their conviction with great certainty that JET--like the competing American projects--will not achieve the "ignited" state of a plasma. But since the examination of this condition is necessary prior to building fusion reactor, it would have been essential to shift these research studies to the next generation of experimental plants--and that would have meant a time delay of at least 10 years in the planning, construction and experimentation period. Thus, it seemed more sensible to many physicists to test an "ignited" plasma parallel to JET in a separate plant. Since this would be directed at only one problem, it could be considerably smaller than the projects of the next generation.

In addition, the project would have fit nicely into the Garching schedules. The two projects in progress there at present, Wendelstein VII and ASDEX, still face a few years of experimenting time; yet the specialists for planning and design are no longer needed there. They are free to prepare other projects, for example, Zephyr. The time to plan and build it would under the best of conditions have been completed just as the other two projects are being finished. Yet nothing has come now of the smooth transition in research work or of the financing.

When the final report on the work for Zephyr is available, the 40 scientists involved will have to consider what they want to do in the future. According to rumors, an American campaign to entice people to leave their employment is in full swing. In the view of the research minister the specialists should rather be involved in JET: "There are voices which maintain that the agreements with JET have not yet been fully exhausted on the part of the Garching people. Perhaps they should now concentrate more on that."

Cancellation of the Zephyr seems final. The new directors of the Max-Planck Institute for Plasma Physics, which during the next few weeks will regularly take over the affairs, will have to consider, together with the scientific management of the institute, how things are to continue. The increasing concentration of the institute on a few large projects, which was systematically strived for in the past few years, has blocked many a path.

In any event, Minister for Research Von Buelow can now express only very vague hopes: "I do not at all wish to exclude the possibility," says the newcomer to the Bonn cabinet, that "we will once again be able to approach the fusion reactor with a big push, on a national basis," if "we can put the fast breeder into the hands of industry." Then Garching can no doubt brood for a long time.

12124
CSO: 5100

RADIOACTIVE WASTE STORAGE, WATER CONTAMINATION PROTESTS

Paris LE MONDE in French 11 Mar 81 p 41

[Article by Jean Rathier, mayor of Saint-Priest-la-Prugne (Loire): "Some Disturbing Revelations" Passages between slantlines originally published in italics]

[Text] Demonstration at Roanne against the plan for a nuclear waste dump at Saint-Priest-la-Prugne.

The plan for installing a radioactive waste dump at Saint-Priest-la-Prugne (Loire) continues to provoke the opposition of a certain number of local representatives and associations. About a thousand, from this and that group, demonstrated Saturday 7 March in the streets of Roanne.

Mr Jean Auroux, Socialist deputy from the Loire, and mayor of the town, as well as Mr Jean Rathier, mayor (without political label) of Saint-Priest-la-Prugne, led the march. The demonstrators symbolically placed mock radioactive cans at different points in the town, particularly in front of the sub-prefecture and the chamber of commerce. No incidents were reported.

Disturbing Revelations

On 15 November 1979, as mayor of Saint-Priest-la-Prugne, I was officially informed of the plan to create a storage center for radioactive waste on my district's territory, at the site of the uranium mine of the Nuclear Materials General Company (COGMEA), which has just shut down. Since that time the National Agency for Managing Radioactive Waste (ANDRA) has distributed several information booklets but their content was vague, incomplete and sometimes conflicting.

After more than a year's struggle by local representatives, gathered together in the committee for safeguarding and developing the Bourbonnais mountains and the Bois-Noirs, of which I am chairman, and by the populations concerned, who formed "Bois Noirs" groups, the veil of mystery is finally being removed. Earlier elements of the case have been changed according to the revelations ANDRA was forced to make, under pressure of our region's representatives and inhabitants. ANDRA justified the selection of Saint-Priest on the grounds that the Atomic Energy Commission (CEA) had acquired familiarity with the area through exploitation of the mine. It based its argumentation on a preliminary study by the Bureau of Geological and Mining Research (BRGM). Today we know this was an unwarranted assertion, which was denied moreover by the BRGM director (LE MONDE of 21 January).

Finally, the sole criterion guiding the selection of my district is a criterion of mere opportuneness: the CEA owns the land. This argument has no scientific merit.

Following the last meeting of the Information Council on Electronuclear Energy, I read the latest document published by ANDRA. /Replies given to the principal questions raised during the local survey./ This booklet partly contradicts the earlier ones and thus simply confirms our fears. It reveals ANDRA's deceitful intent in this matter. It is acknowledged that part of the waste stored would come from retreatment centers of the Hague and would contain long-life radioelements whose content-limit would be fixed /later./ This had been strongly denied in the information booklets distributed to the public.

As a new development, it is also acknowledged that low and mid-grade wastes containing a significant quantity of long-life radioelements with potentially highly harmful effects/ would be /stored/. This storing could be planned for twenty or thirty years.

Thus, contrary to ANDRA's previous assertions, Saint-Priest would become a /storing/ center for waste containing alpha emitters and a /storing/ center for alpha waste whose harmful effects are recognized by the promoters themselves!

This is all the more serious since, according to scientists' assertions, it is very difficult to detect alpha emitters when mixed with others; beta and gamma radiation, having a longer range, tend to mask them. As one of the ANDRA officials acknowledged, /We do not have the means to check on COGEMA... we have to trust COGEMA./

It has been emphasized since the beginning of the affair that ANDRA is a public enterprise providing every assurance concerning the oepration of the center. However, that is meaningless because since 1 January 1981 ANDRA has entrusted the management of the storing centers to a company The Industrial Storing and Decontamination Company. Why this new deception?

Before concluding, I repeat that neither the general councils of the Allier and the Loire departments, nor the regional council of Auvergne has approved the plan and more than 60 communes have rejected it. Finally, the letter that the council presided over by Mme Veil has just sent the prime minister, serves to confirm the correctness of our criticisms.

Therefore, on the basis of all the new facts brought to bear on the case, and considering that Bois-Noirs constitutes a regional "water tower", its deep waters assuredly connected with certain Vichy springs, supplying nearly one hundred twenty communes; and in accordance with the will of the people of my commune, I ask for the permanent withdrawal of the plan.

9772
CSO: 5100

ELECTRONUCLEAR PROGRAM'S STATUS, PROGRESS CHARTED

Paris CEA NOTES D'INFORMATION in French Dec 80 pp 14-21

[Study conducted by the Program Department of CEA-GIDE by J.-C. Leralle]

[Text] Beginnings of Nuclear Program

From 1954 to 1973, France readied and placed in operation nine uranium-fueled nuclear power plants: graphite-gas (UNGG) -- first generation of French electricity generating installations -- and three prototype installations -- EL 4 (heavy water-gas), Chooz (PWR-300), and Phenix (breeder reactor).

Development of Light-Water Cooled Plants

Since the end of 1969, the French electronuclear program has been essentially based on the development of pressurized light water reactors (PWR). The various electricity-producing nuclear plants involved are part of multi-year programs or contracts representing agreements between the National Electricity Company (EDF) and the French builder Framatome. These plants were developed for two power levels: 900 MWe and 1300 MWe.

The 900 MWe level includes:

The "1970" programs, implemented in October 1970 the PWR option through the placement of an initial order with Framatome. These "1970" programs covered six plants;

The first 900-1 Multi-Year Contract initiated at the beginning of 1974 for 16 plants (two firm orders and four options);

The second 900-2 Multi-Year Contract initiated at the end of 1975 for eight plants, and extended during 1980 to 12 plants (four firm orders, four initial options, and four additional options).

Only two options remained open at the end of December 1980 (extension of CP-900-2): Chinon B-3 (planned for June 1981) and Chinon B-4 (planned for February 1982).

The 1300 MWe PWR level can be divided into three phases:

The first 1300-1 Multi-Year Contract initiated at the end of 1975 for eight plants (four firm orders and four options);

The second 1300-2 Multi-Year Contract for eight plants (four firm orders and four options), concluded on 7 August 1980 between EDF and Framatome;

Projected 1300 MWe PWR plants on which work can begin starting in 1982 through new contracts between Framatome and EDF.

The announcement in April 1979 by the President, that the French electronuclear program will be accelerated, and the contract authorizations granted to EDF by the government, made it possible to begin work as had been planned, in December 1979, on Cattenom-1, the first unit of the 1300-2 Multi-Year Contract.

By the end of December 1980, work had been started on the eight plants of the 1300-1 Multi-Year Contract, as well as on two plants of the 1300-2 Multi-Year Contract (Cattenom 1 and 2). Construction orders are planned for the last two firm orders in February and September 1981, and for the four options in December 1981, and May, July, and September 1982.

Development of Electricity-Producing Breeder Reactors

For over 20 years, the AEC together with EDF and industry has actively developed sodium-cooled fast-neutron breeder reactors. Construction of the non-producing experimental reactor Rapsodie, completed in 1967, marked the first stage of this program.

The second stage, Phenix, a 250 MWe demonstration power plant, was placed in operation in 1973. The program is proceeding with the construction, at Creys-Malville, of Super-Phenix, a 1200 MWe industrial prototype whose contract was awarded to Novatome Industrie. This plant is expected to go into operation in 1983.

The next stage will be the completion of a series of several identical plants which could go into operation starting in the 1990's; the first order could be placed before 1985.

The French Electronuclear Inventory

At the end of December 1980, this inventory included:

Twenty-three installed plants (first criticality reached), or 15,596 net MWe:
    8 "old nuclear" plants* (six UNGG, one PWR, EL-4);
    1 Phenix breeder reactor;
    14 "new nuclear" PWR-900 plants.

Twenty units (six UNGG, one PWR-300,, EL4, Phenix, and 11 PWR-900) are in industrial operation, and represent 12,[illegible] net MWe.

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*"old nuclear": reactors placed in service before 1972.

Twenty nine plants under construction, or 30,190 net MWe:
- 17 PWR-900 plants;
- 10 PWR-1300 plants;
- 1 Super-Phenix breeder reactor.

St-Laurent B-1 and Dampierre 3, whose initial fuel loading has been completed, could reach criticality during January 1981.

Three "old nuclear" plants have already been shut down:

Marcoule G-1, the first French unit to produce nuclear-powered electricity on 28 September 1956; permanently shut down on 15 October 1968.

Chinon A-1 or EDF-1, the first prototype installation built for EDF, coupled to the network on 15 June 1963 and permanently shut down on 2 February 1973.

Marcoule G-2, coupled to the network on 22 April 1959, and permanently shut down on 2 February 1980.

Continuing plans for the French inventory provide at first, through approved commitments, for work to begin on four new plants by the end of 1981, representing 4695 net MWe:

- 2 PWR-1300, on firm order with Framatome, for 2550 net MWe;
- 1 PWR-900, and 1 PWR 1300 currently under option, for 2145 net MWe.

These should go into operation between 1986 and 1987.

In addition, authorization has been given for work to begin in 1982 on five plants (one PWR-900 and four PWR-1300) for 5970 net MWe, and in 1983 on four PWR-1300 plants, for 5080 net MWe. These should go into operation in 1987, 1988, and 1989.

Objectives

According to consumption projections being considered, development of the French electronuclear inventory could continue beyond 1989 with the placement in service, each year, of several PWR-1300 plants, and starting in the 1990's, of several breeder reactor units of 1500 MWe each.

Based on current industrial operation projections, French electronuclear power could amount to:

- End 1981, 17,376 net MWe (25 plants);
- End 1985, 38,223 net MWe (44 plants);
- End 1990, 66,400 net MWe (64 plants);

Beyond 1987, the possibilities being considered are:

- In 1988, 4 PWR-1300;
- In 1989, 5 PWR-1300;
- In 1990, 4 PWR-1300.

Events of 1980

Criticality reached:

Tricastin-1	2/21/80	coupling 5/31/80
Gravelines B-1	2/21/80	coupling 3/13/80
Dampierre-1	3/15/80	coupling 3/23/80
Tricastin-2	7/22/80	coupling 8/7/80
Gravelines B-2	8/2/80	coupling 8/26/80
Tricastin-3	11/29/80	coupling January 1981
Gravelines B-3	11/30/80	coupling 12/12/80
Dampierre-2	12/5/80	coupling 12/10/80

Work started (construction order issued to Framatome):

PWR-1300		
Paluel-4	March 1980	(CP-1300-1, option exercised)
St Alban-St Maurice-2	April 1980	(CP-1300-1, option exercised)
Flamanville-2	June 1980	(CP-1300-1, option exercised)
Cattenom-2	September 1980	(CP-1300-2, firm order)
PWR-900		
Gravelines C-6	September 1980	(CP-900-2 extension, option exercised)

Completed placement in industrial service:

PWR-900		
Bugey-5	on 1/3/80	(programs 70)
Dampierre-1	on 9/10/80	(CP-900-1)
Gravelines B-1	on 11/25/80	(CP-900-1)
Tricastin-1	on 12/2/80	(CP-900-1)
Tricastin-2	on 12/2/80	(CP-900-1)
Gravelines B-2	on 12/4/80	(CP-900-1)

Projected placement in industrial service (plants installed or fuel loading completed) -- From EDF General Economic Studies, September 1980:

St-Laurent B-1	November 1981
Tricastin-3	August 1981
Dampierre-2	September 1981
Gravelines B-3	August 1981
Dampierre-3	November 1981

Continuing operation for Marcoule G-3:

In December 1980, the Marcoule G-3 reactor will begin a new cycle of operation expected to last 18 months. No definite decision for shutdown has been made so far. The ELECNUC* data bank shows June 1982 as the date chosen for eventual shut down.

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*ELECNUC: AEC-DPg Worldwide Nuclear Plant Data Bank.

Operating conditions for UNGG plants:

Since 1 April 1979, the net sustained power (PCN) of the plants has been reduced to the following values:

Chinon A-2	180 instead of 210 net MWe
Chinon A-3	360 instead of 400 net MWe
St-Laurent A-1	390 instead of 460 net MWe
St-Laurent A-2	450 instead of 515 net MWe

Sites and Procedures

Declarations of public utility (DUP) in 1980:

Nogent 1 and 2	obtained 3/29/80 (requested 6/5/78)
Penly 1, 2, 3, and 4	obtained 3/29/80 (requested 6/21/78)
Golfech 1, 2, 3, and 4	obtained 10/28/80 (requested 6/29/79)
Plogoff 1, 2, 3, and 4	obtained 12/1/80 (requested 6/29/80)

Current requests:

Chinon B-3 and B-4	(requested 10/15/79)
Chooz B-1, B-2, B-3, and B-4	(requested 10/16/79)

Approvals for construction (DAC) in 1980:

Le Blayais 3 and 4	obtained 2/5/80 (requested 10/3/77)

Current applications:

Belleville 1, 2, 3, and 4	(requested 3/13/78)
Cattenom 1 and 2	(requested 2/24/78)
Cruas 1, 2, 3, and 4	(requested 6/14/77)
Gravelines C-5 and C-6	(requested 6/29/79)
Le Pellerin 1, 2, 3, and 4	(requested 9/14/78)
Nogent 1 and 2	(requested 2/14/79)
Paluel 3 and 4	(requested 2/8/78)
St-Maurice 1, 2, 3, and 4	(requested 2/24/78)

Building permits (new conditions applied to nuclear plants since 1977):

Nogent 1 and 2	obtained on 9/10/80 (requested 4/16/80)
Chinon B-3 and B-4	obtained 10/13/80 (requested 6/20/80)

Current applications:

Penly 1, 2, 3, and 4	(requested 10/17/80)

Case of Cattenom 3 and 4:

The DUP issued on 10/11/78 for the Cattenom site covered the installation of two PWR-1300 and two PWR-900. EDF having subsequently proposed the installation of four PWR-1300, was the DUP issued still valid?

Upon consultation, the Council of State declared that the DUP was valid despite the power modifications, and that a local inquiry would not be necessary with the request for construction authorization.

Sites for which procedures have not been undertaken, but could be planned:

Vienne-Civaux	DUP application planned for the beginning of 1981
Massif Central-Allier Site	DUP application planned for mid-1981 or early 1982
Paris Region	DUP application planned for the end of 1981-1982
Pyrenees	

No site has been selected for these last three regions.

Table 1. French electronuclear program by year of construction and by plant.

Le programme électronucléaire français par année de mise en chantier et par tranche

		MWe	(A) Mise en Chantier	(B) Mise en service industriel
de 1954 à 1968				
Marcoule G-1	×	2	1954	1956
Marcoule G-2	×	38	1955	1959
Marcoule G-3		38	1956	1960
Chinon A-1		70	1957	1964
Chinon A-2		210	1958	1965
Chinon A-3		480	1961	1967
Chooz A-1		310	1962	1970
Monts d'Arrée		70	1962	1967
St-Laurent A-1		480	1963	1969
Bugey-1		540	1965	1972
St-Laurent A-2		515	1966	1971
Phénix		233	1968	1974
Programmes 1970				
Fessenheim-1		880	1970	1977
Fessenheim-2		880	1971	1978
Bugey-2		920	1972	1979
Bugey-3		920	1972	1979
Bugey-4		900	1973	1979
Bugey-5		900	1974	1980
Contrat Pluri annuel 900-1 (C)				
Tricastin-1	*	920	1974	1980
Gravelines B-1	*	920	1974	1980
Dampierre-1	*	900	1974	1980
Tricastin-2	*	920	1974	1980
Gravelines B-2	*	920	1975	1981
Dampierre-2	*	900	1975	1981
Tricastin-3	*	920	1975	1981
Gravelines B-3	*	920	1975	1981
Dampierre-3		900	1975	1981
Tricastin-4		920	1975	1982
Gravelines B-4		920	1976	1982
St-Laurent B-1		880	1976	1981
Dampierre-4		900	1976	1982
St-Laurent B-2		880	1976	1982
Le Blayais-1		920	1976	1982
Le Blayais-2		920	1977	1982
Contrat Pluriannuel 900-2 (D)				
Chinon B-1		870	1977	1983
Chinon B-2		870	1977	1983
Le Blayais-3		920	1977	1983
Le Blayais-4		920	1978	1983
Cruas-1		880	1978	1984
Cruas-2		880	1978	1984
Cruas-3		880	1979	1984
Cruas-4		880	1979	1985
Contrat Pluriannuel 900-2 étendu (E)				
Gravelines C-5		920	1979	1985
Gravelines C-6		920	1980	1986
Chinon B-3		870	1981	1986
Chinon B-4		870	1982	1987
Contrat Pluriannuel 1 300-1 (F)				
Paluel-1		1 285	1977	1984
Paluel-2		1 285	1977	1984
Paluel-3		1 285	1978	1984
St-Maurice-1		1 275	1979	1985
Flamanville-1		1 285	1979	1985
Paluel-4		1 285	1980	1986
St-Maurice-2		1 275	1980	1986
Flamanville-2		1 285	1980	1986
Surgénérateur 1 200 (G)				
Creys-Malville		1 200	1976	1984
Contrat Pluriannuel 1 300-2 (H)				
Cattenom-1		1 275	1979	1986
Cattenom-2		1 275	1980	1986
Belleville-1		1 275	1981	1987
Nogent-1		1 275	1981	1987
Belleville-2		1 275	1981	1987
Cattenom-3		1 275	1982	1988
Nogent-2		1 275	1982	1988
Golfech-1		1 275	1982	1988
Projets 1 300 (I)				
Chooz B-1		1 275	1982	1988
Cattenom-4	○	1 275	1983	1989
Penly-1	○	1 275	1983	1989
Golfech-2	○	1 275	1983	1989
Chooz B-2	○	1 275	1983	1989

× Tranches définitivement retirées de l'exploitation
* Divergences réalisées entre le 1.1.1980 et le 31.12.1980
○ Site non confirmé

Tableau 1

Key to table 1:

- (A) Construction started
- (B) Placed in industrial service
- (C) 900-1 Multi-Year Contract
- (D) 900-2 Multi-Year Contract
- (E) Extended 900-2 Multi-Year Contract
- (F) 1300-1 Multi-Year Contract
- (G) 1200 Breeder reactor
- (H) 1300-2 Multi-Year Contract
- (I) 1300 Projects

X Plants permanently shut down
* Criticality reached between 1/1/80 and 12/31/80
o Site not confirmed

Table 2. Development forecast for the French nuclear inventory from 1980 to 1990.

From the EEG-EDF forecast of September 1980, and considering various MSI predictions starting in 1988.

Les prévisions de développement du parc nucléaire français de 1980 à 1990

A partir des prévisions des EEG-EDF de septembre 1980, et en prenant en compte certaines hypothèses de MSI à partir de 1988.

Tranches mises en service industriel (A)	Filière (B)	Puissance en MWe nets (C)	Puissance en MWe nets (E) Cumulée	Nombre de (3) tranches (F) annuel	Nombre de tranches (D) cumulé	Nombre de tranches total
Au 1.1.1980	Graphite-gaz (G) Eau lourde-gaz (H) Surgénérateur (I) PWR 300 PWR 900	2 301 70 233 310 4 500	7 414	7 1 1 1 5	5	15
en 1980 (1) Au 31.12.1980	PWR 900	5 480	12 856	6	11	20
en 1981	PWR 900	4 520	17 376	5	16	25
en 1982 (2)	PWR 900	5 480	22 798	6	22	30
en 1983	PWR 900	3 580	26 378	4	26	34
en 1984	Surgénérateur PWR 900 PWR 1 300	1 200 2 640 3 855	34 073	1 3 3	 29 3	41
en 1985 (2)	PWR 900 PWR 1 300	1 800 2 560	38 223	2 2	31 5	44
en 1986	PWR 900 PWR 1 300	1 790 6 395	46 408	2 5	33 10	51
en 1987 (2)	PWR 900 PWR 1 300	870 3 825	50 243	1 3	34 13	52
en 1988	PWR 900 PWR 1 300	— 5 100	55 343	0 4	34 17	56
en 1989 (2)	PWR 900 PWR 1 300	— 6 375	61 238	0 5	34 22	60
en 1990	PWR 900 PWR 1 300	— 5 100	66 338	0 4	34 26	64

REMARQUES

(1) *Retrait de l'exploitation de G-2 au début de l'année 1980*

(2) *Hypothèses de retrait de l'exploitation (sans que la décision définitive ait été arrêtée)* en 1982 G-3, en 1985 Chinon A-2, en 1987 Chooz A-1, EL-4, Chinon A-3, en 1989 St-Laurent A-1.

(3) Hypothèse de mise en service de 1988 de 4 × 1 300, en 1989 de 5 × 1 300 et en 1990 4 × 1 300 à engager à partir de 1982

Tableau 2

Key to table 2:

(A) Plants placed in industrial service
(B) Type of installation
(C) Power in net MWe
(D) Number of plants
(E) Cumulated
(F) Annual
(G) Graphite-gas
(H) Heavy water-gas
(I) Breeder reactor
(J) Au = on; en = in

Notes: (1) Shut down of G-2 at the beginning of 1980
(2) Presumption of shut-down (without final decision having been reached): G-3 in 1982, Chinon A-2 in 1985, Chooz A-1, EL-4, and Chinon A-3 in 1987, St-Laurent A-1 in 1989
(3) Presumption of placement in operation of 4 X 1300 in 1988, 5 X 1300 in 1989, and 4 X 1300 in 1990, to be started beginning in 1982

Table 3. Projected actual duration of construction and cimpact on development of the French nuclear inventory from 1980 to 1990.

Evaluation based on the situation at the end of October 1980.
Taking into consideration the following assumptions:
Execution orders to Framatome are maintained at the dates shown in table 1;
The duration of construction of the 900 plants (MSI-Date of execution order) used for the plants currently not coupled into the network is equal to the average of the duration recorded for the 900 plants currently coupled (6.4 years);
The duration of construction of the 1300 plants is equal to 6.4 + 0.5 years (or an additional six months).

Projection des durées actuelles de construction et conséquences sur le développement du parc nucléaire français de 1980 à 1990

Évaluation faite à partir des situations à la fin octobre 1980
Prise en compte des hypothèses suivantes
- les ordres d'exécution à Framatome sont maintenus aux dates prises en compte dans le tableau 1 ;
- **la durée de construction des tranches 900** (MSI Date d'ordre d'exécution) **prise pour les tranches actuellement** non couplées au réseau est **égale à la moyenne de la durée constatée pour les tranches 900 actuellement couplées** (soit 6,4 ans) ;
- **la durée de construction des tranches 1 300 est prise égale à 6,4 ans + 0,5 an (soit 6 mois de plus).**

Tranches mises en service industriel (A)	Filière (B)	Puissance en MWe nets (C)		Nombre de (D) tranches		
			(E) cumulée	(F) annuel	(E) cumulé	total
au 1-1-1980	Graphite-gaz (G) Eau lourde-gaz (H) Surgénérateur (I) PWR 300 PWR 900	2 301 70 233 310 4 500	7 414	7 1 1 1 5	5	15
en 1980 (1) au 31-12-1980	PWR 900	5 480	12 856	6	11	20
en 1981	PWR 900	2 740	15 596	3	14	23
en 1982 (2)	PWR 900	4 540	20 098	5	19	27
en 1983	PWR 900	4 440	24 538	5	24	32
en 1984	Surgénérateur PWR 900 PWR 1 300	1 200 2 720 2 570	31 028	1 3 2	 27 2	38
en 1985 (2)	PWR 900 PWR 1 300	1 760 1 285	33 863	2 1	29 3	40
en 1986	PWR 900 PWR 1 300	2 720 5 120	41 703	3 4	32 7	47
en 1987 (2)	PWR 900 PWR 1 300	870 5 110	46 823	1 4	33 11	49
en 1988	PWR 900 PWR 1 300	870 2 550	50 243	1 2	34 13	52
en 1989 (2)	PWR 900 PWR 1 300	— 5 100	54 863	0 4	34 17	55
en 1990	PWR 900 PWR 1 300	— 3 825	58 688	0 3	34 20	58

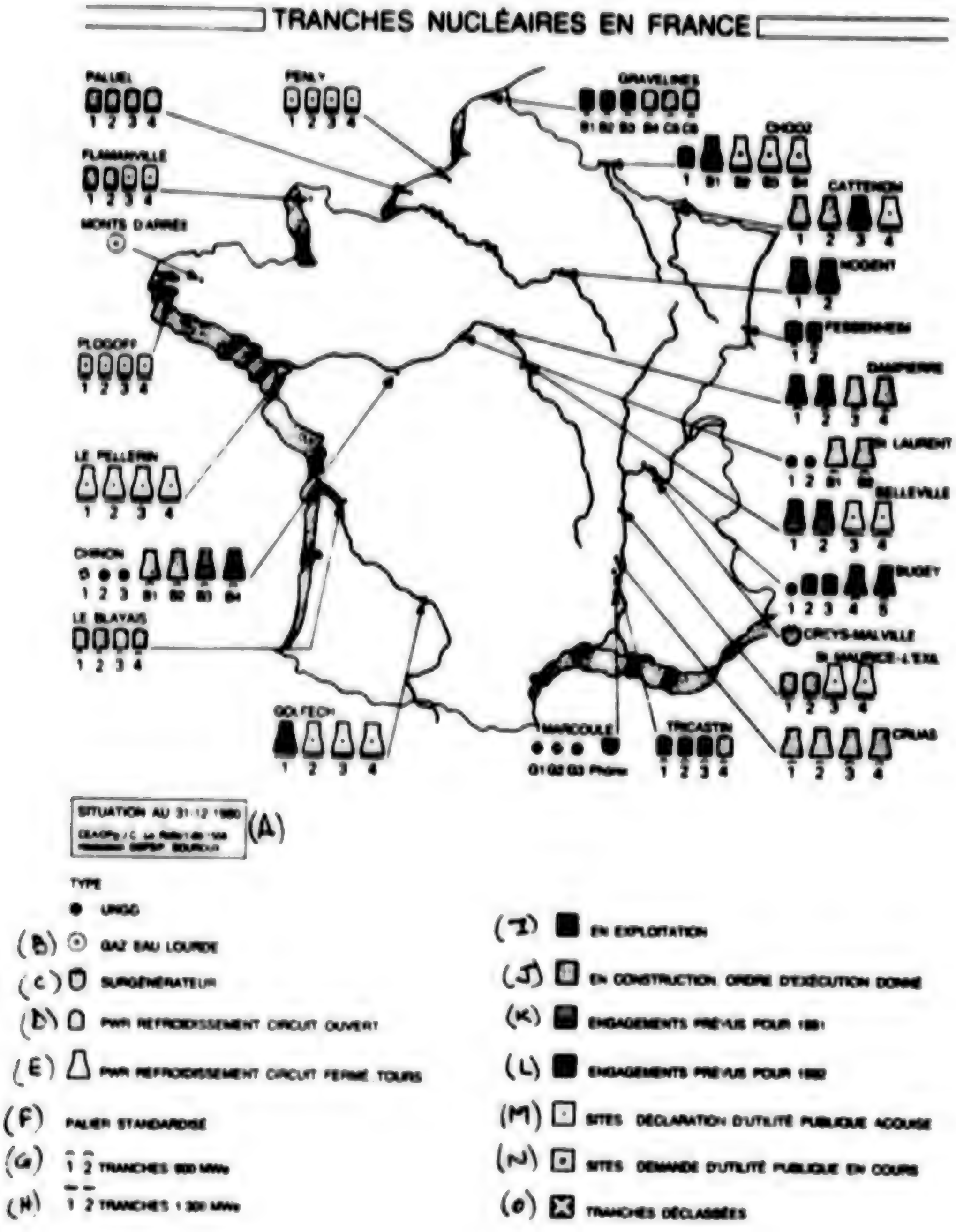
Tableau 3

(1) (2) Voir tableau 1

Key to table 3:

(A) Plants placed in industrial service
(B) Type of installation
(C) Power in net MWe
(D) Number of plants
(E) Cumulated
(F) Annual
(G) Graphite-gas
(H) Heavy water-gas
(I) Breeder reactor
(J) Au = on; en = in
(1) (2) See table 1

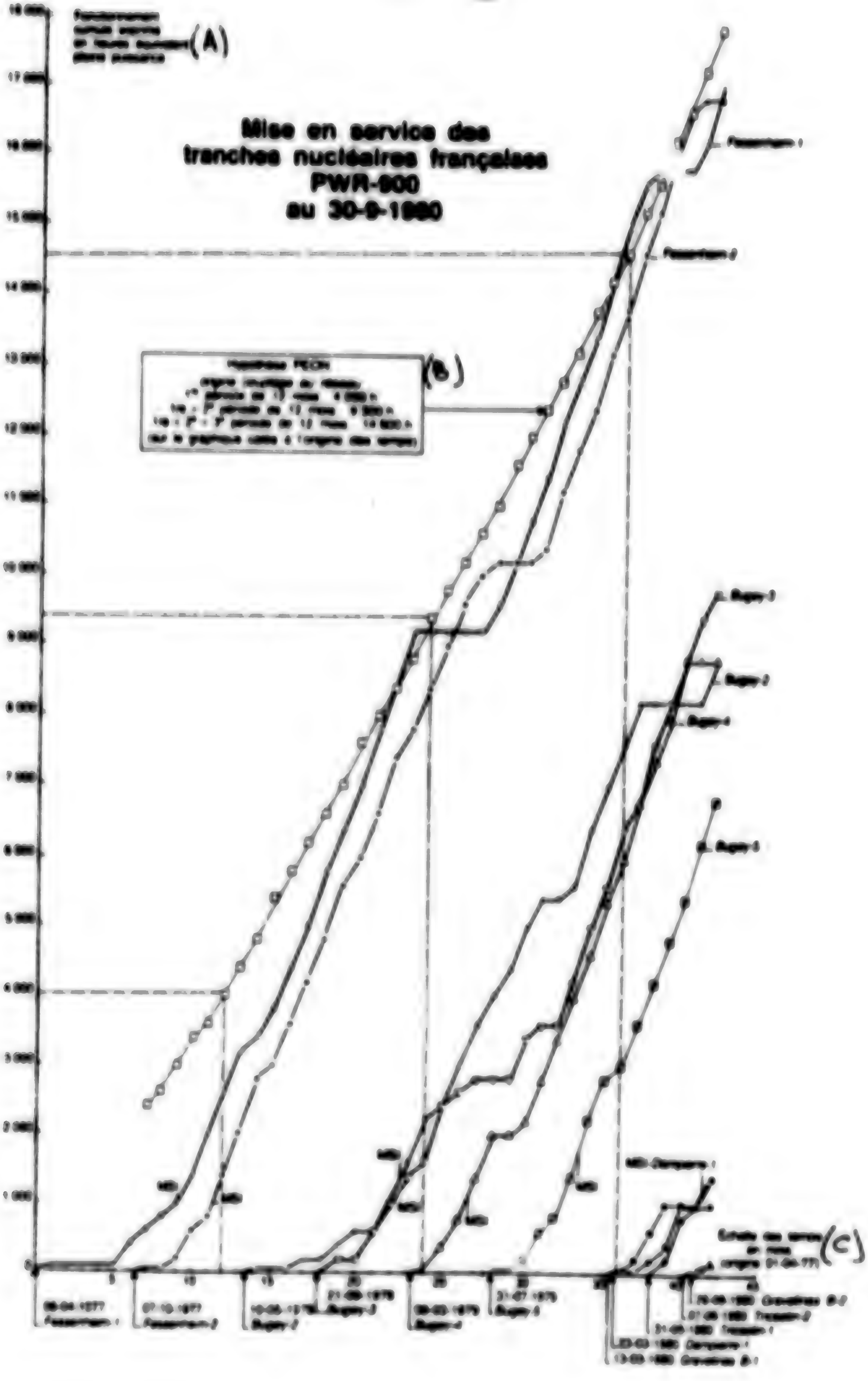
Figure 1. Nuclear plants in France



Key to figure 1:

(A) Situation on 31 December 1980
(B) Gas heavy water
(C) Breeder reactor
(D) Open circuit cooling PWR
(E) Closed circuit cooling towers PWR
(F) Standardized level
(G) 900 MWe plants
(H) 1300 MWe plants
(I) In operation
(J) Under construction, execution order issued
(K) Commitments planned for 1981
(L) Obligations planned for 1982
(M) Sites: declaration of public utility obtained
(N) Sites: request for public utility made
(O) Plants shut down

Figure 2. Placement in operation of PWR-900 French nuclear plants as of 9/30/80.



Key to figure 2:

(A) Cumulated operation expressed in full power equivalent hours

(B) PEON assumption
Origin of coupling to network
1st 12-month period: 4000 hours
1st + 2nd 12-month period: 9300 hours
1st + 2nd + 3rd 12-month period: 14,600 hours
(on the graph fixed at the time origin)

(C) Time scale in months (origin 4/1/77)

Figure 3. Simplified nuclear plant construction chart.

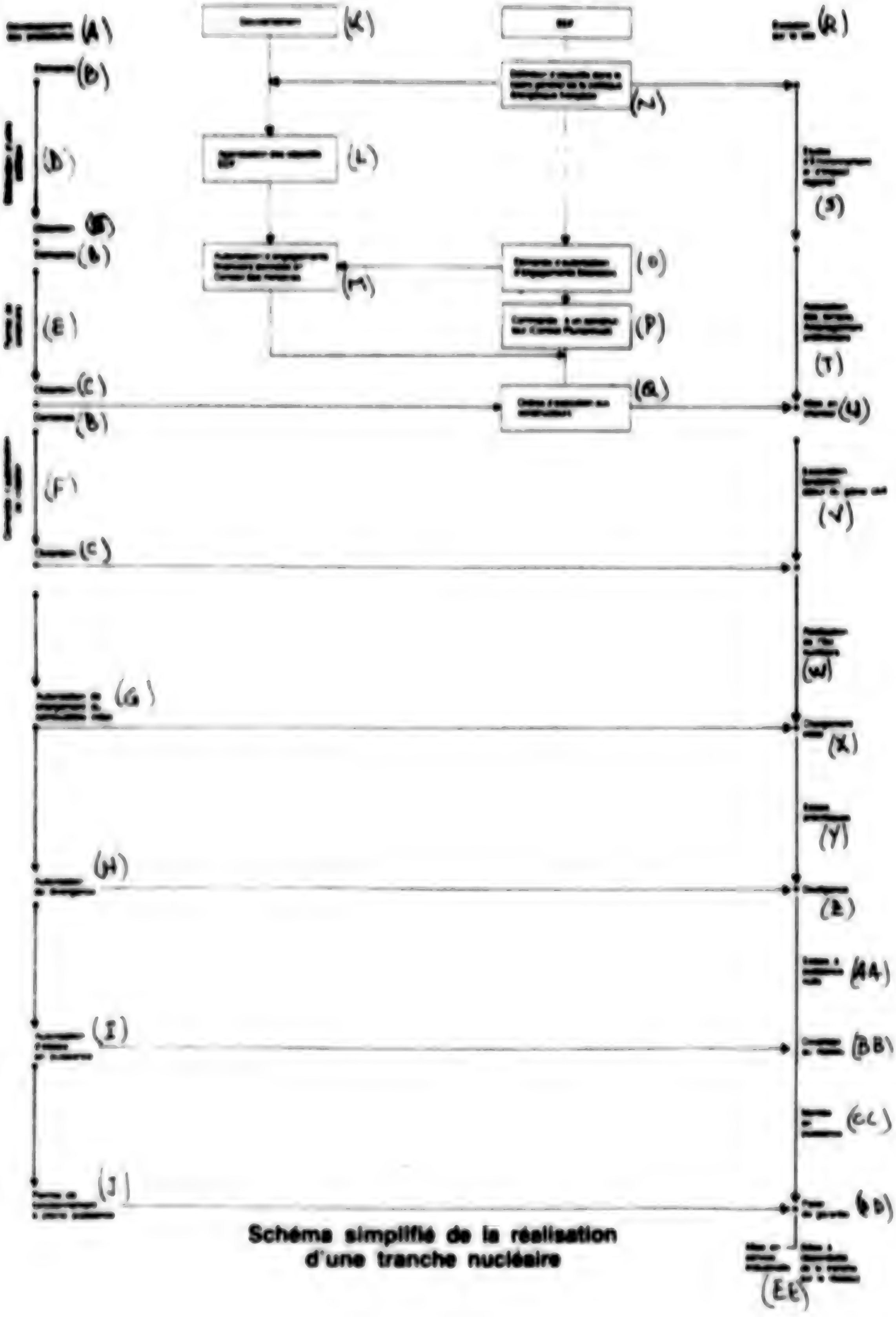


Schéma simplifié de la réalisation d'une tranche nucléaire

Key to figure 3:

(A) Development of procedures
(B) Request
(C) Approval
(D) Declaration of public utility
(E) Building permit
(F) Request for construction authorization
(G) Authorization for loading initial fuel
(H) Authorization for criticality
(I) Authorization for power tests
(J) Permit for full power operation
(K) Government
(L) Approval of EDF objectives
(M) Authorization of financial commitments given by the Council of Ministers
(N) Definition of objectives congruent with general French energy policy
(O) Request for authorization for financial commitments
(P) Order to builder (multi-year contract)
(Q) Execution orders to builders
(R) Progress at site
(S) Environmental and regional impact studies
(T) Land acquisition. Preliminary preparation
(U) Inception of construction
(V) Excavation, foundations, beginning of civil engineering
(W) Construction of the nuclear island
(X) Initial loading
(Y) Precritical tests
(Z) Criticality
(AA) Zero power tests
(BB) Coupling to network
(CC) Power increase
(DD) Guarantee threshold
(EE) Placement in industrial service (Plant made available to the network)

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BRIEFS

RESEARCH REACTOR GOES CRITICAL--The Orphee research nuclear reactor went critical on 19 December 1980 at 0630 hours at the Saclay Nuclear Research Center (CEN). Orphee is a 14 thermal megawatts pool-reactor designed to provide neutron beams for basic research requirements, notably studies on the structure of materials and the study of energy states in condensed matter. Until now, this research has been conducted at Saclay with beams from the old polyvalent reactor EL 3 (basic research and technical radiation), which went operational in 1957. EL 3 was shut down in March 1979 and is currently being dismantled. Orphee will be operated by the Leon Brillouin Laboratory which is a joint group of AEC's Basic Research Institute and CNRS. Experiments will be conducted by biologists, chemists, metallurgiests and physicists. Orphee was built by the AEC with the assistance of Technicatome. This very modern research reactor is an illustration of the rank achieved by France in the field. After renovation of the Saturne accelerator, the opening of this new facility confirms the role which Saclay's CEN is destined to play as one of the focal points of basic research in coming decades. [Text] [Paris CEA NOTES D'INFORMATION in French Dec 80 p 22]

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NETHERLANDS

LABOR PARTY CONGRESS WANTS END TO NUCLEAR POWER

Rotterdam NRC HANDELSBLAD in Dutch 27 Feb 81 p 3

[Text] Amsterdam 27 Feb--The PvdA [Labor Party] election congress thinks that the nuclear power plants in Dodewaard and Borsele must be closed as soon as possible from a technical standpoint. Moreover, according to the congress, the Netherlands must stop its contributions to the breeder reactors established abroad (Kalkar in the Federal Republic of Germany and Superphoenix in Creys-Malville, France).

The congress, which with this went further than the party executive committee had proposed, rejected test explorations in salt domes as superfluous. According to the congress' wish, nuclear fission research will only focus on safe dismanteling and salvage of fission systems in use and on medical applications of nuclear physics.

Developments in nuclear physics research abroad are being closely followed, but the money which previously was earmarked here for such research must be invested especially, to a considerable extent in the future, in research in renewable energy sources (wind and solar power).

With a view to increased use of coal, according to the PvdA Congress, research on the environmental results of the use of fossil fuels (especially coal) must be promoted vigorously. In addition, in order to insure the energy supply, a state enterprise must be created for purchase and sale, exploration and utilization of coal, oil and gas. It must operate competitively beside the existing energy companies. The congress rejected an amendment which wanted to put all energy utilization and exploration directly in community hands.

In addition, the Netherlands must advocate in international organizations closing of nuclear power plants abroad.

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10 April 1980